CRYSTALLINE STRUCTURES AND COMPOSITIONAL DEPTH PROFILE OF SOLUTION DERIVED LEAD-FREE $(Bi_{0.5}Na_{0.5})_{1-x}Ba_xTiO_3$ (BNBT) THIN FILMS AROUND THE MORPHOTROPIC PHASE BOUNDARY

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$(Bi_{0.5}Na_{0.5})_{1-x}Ba_xTiO_3$ (BNBT) is considered a promising lead-free alternative to MPB-$Pb(Zr_x,Ti_{1-x})O_3$(PZT). It shows the coexistence of rhombohedral (R3c) and tetragonal (P4mm) crystalline structures in the proximity to the MPB (x~0.06). In this work, BNBT thin films were fabricated by chemical solution deposition (CSD) with a wide range of compositions (x=0.050-0.150) onto $Pt/TiO_2/SiO_2/(100)Si$ substrates, from hybrid precursor solutions. Stoichiometric thin films (hereinafter BNBT) and others containing Na^++Bi^{3+} excesses (BNBTxs) were prepared. Na^+ and Bi^{3+} are highly volatile at the crystallization temperatures, and traditionally small excesses of these elements are added to the precursor solution to compensate any possible loss. Structural studies by X-ray diffraction using the λ_{Cu}=1.54 Å and synchrotron radiation with λ=0.97354 Å were performed to determine the crystalline structure of the films. Rietveld analysis of the experimental X-ray patterns showed different phase volume fractions of the rhombohedral-tetragonal phases as a function of the Ba^{2+} content and a shift of the position of the MPB with the introduction of Na^++Bi^{3+} excesses. MPB was around x~0.055 and x~0.10 for the BNBT and BNBTxs, respectively. Rutherford backscattering experiments (RBS) were performed to study the compositional profile of the films. This study revealed bismuth excess is not volatilized during crystallization of the BNBTxs films, but forming instead thick Bi_xPt bottom interfaces. RBS also indicated that the BNBT films with x~0.055 have a homogeneous compositional profile and again it is confirmed the coexistence of rhombohedral and tetragonal phases, which is accompanied by well-defined ferroelectric hysteresis loops with comparatively high values of remnant polarizations.

Acknowledges

This work has been supported by the Spanish Project MAT2010-15365. D. Pérez-Mezcua acknowledges the financial support of the CSIC JAE- Predoc grant. Dr.I. Bretos acknowledges the financial support of the Juan de la Cierva programme. Dr. R. Escobar Galindo acknowledges support through Ramon y Cajal programme (RyC2007-0026). The authors would like to thank L. Lutterotti the development of MAUD program.